(12) UK Patent Application (19) GB (11) 2 176 404 A

(43) Application published 31 Dec 1986

(21) Application No 8514968

(22) Date of filing 13 Jun 1985

(51) INT CL[4]
A62B 18/02

(52) Domestic classification (Edition H)
A5T CB

(56) Documents cited
None

(58) Field of search
A5T
Selected US specifications from IPC sub-class A62B

(71) Applicant
Odessky Gosudarstvenny Universitet Imeni I. I. Mechnikova (USSR),
Ulitsa P Velikogo, 2 Odessa, Union of Soviet Socialist Republics

(72) Inventors
Alim Abdul-Amidovich Ennan,
Valentin Iliich Baidenko,
Oleg Alexandrovich Kovalev,
Natalya Nikolaevna Abramova,
Litvin Eligumovich Kazarian,
Mkrtych Mikhailovich Agababian,
Eduard Pavlovich Akopian,
Alexandr Pavlovich Kozak

(74) Agent and/or address for service
Marks & Clerk, 57—60 Lincoln's Inn Fields, London WC2A 3LS

(54) Respirator

(57) The respirator comprises a mask 1 with two layers 7, 13 of different filtering materials arranged thereon and elements for its securing to the face. The respirator is provided with an exhalation valve 3 detachably secured in an opening 6 of the mask 1. One layer 7 of the filtering material possesses aerosol filtering properties and is secured outside the mask 1 by means of a bracing cord 10; the valve 3 projects outside this layer. The edge 8 of this layer 7 is folded over the edge of the mask 1 and is braced by the cord 10. The second layer 13 of filtering material possesses chemisorption gas absorptive properties and is secured inside the mask 1 so that its edge 15 fits the edge 8 of the first layer 7 and the valve 3 projects from the layer 13 inside the mask 1.

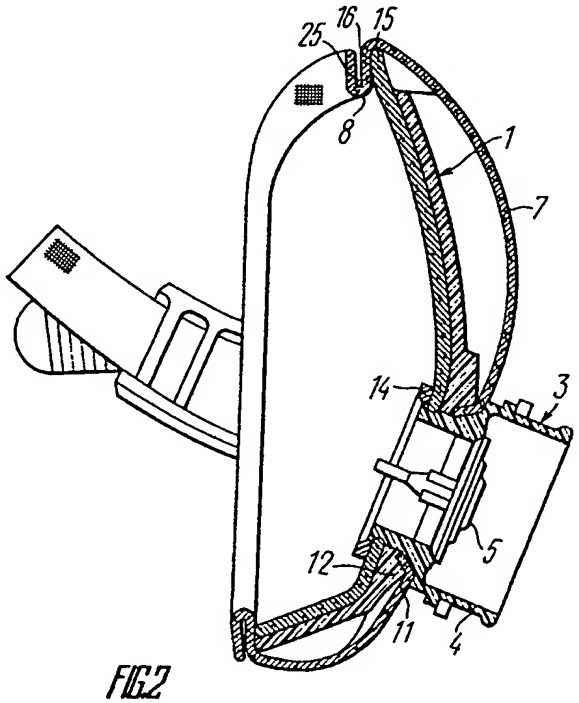

FIG.2

GB 2 176 404 A

2176494

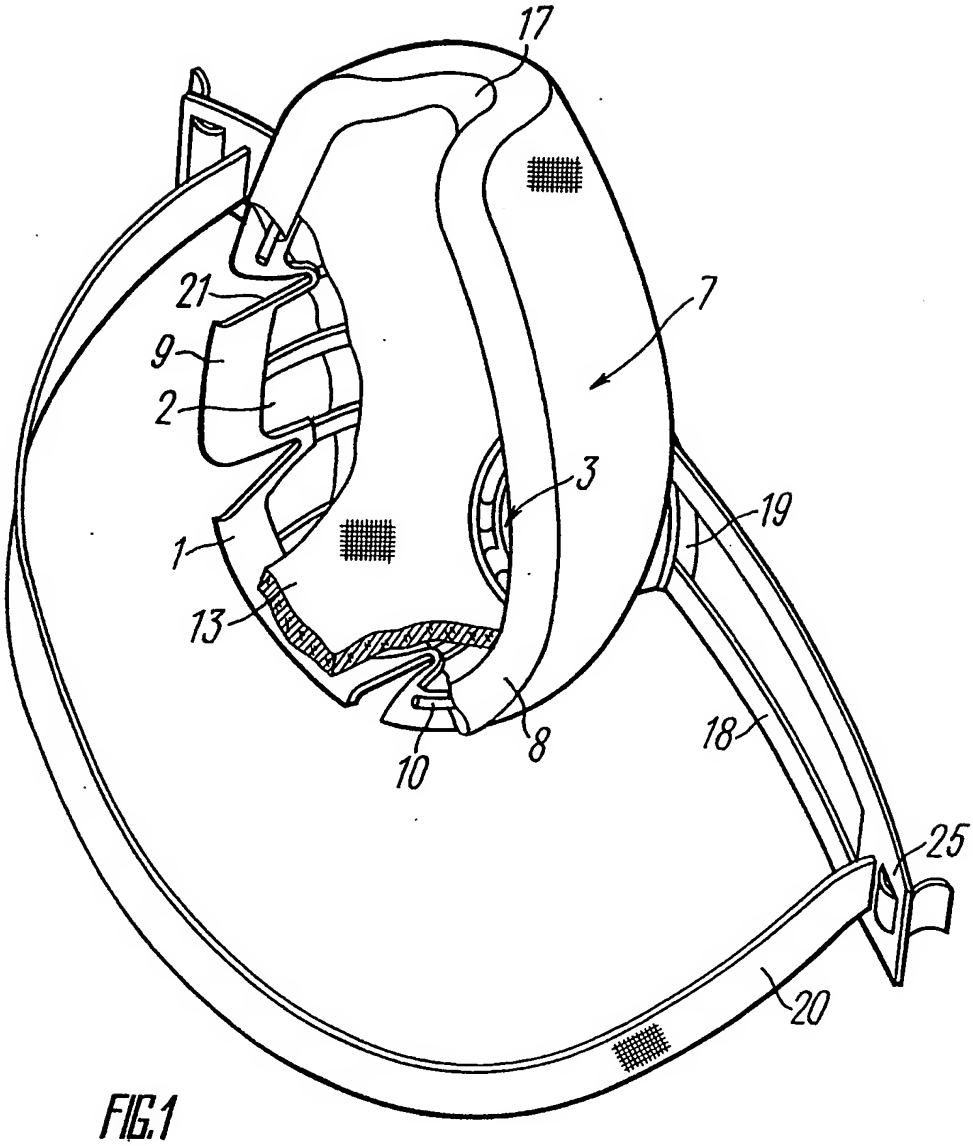

FIG.1

2176494

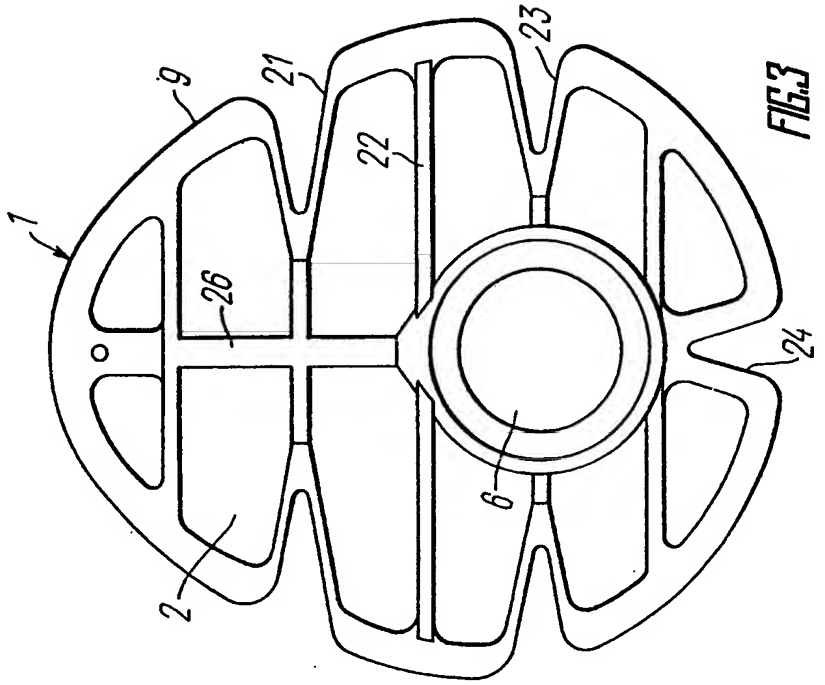

FIG3

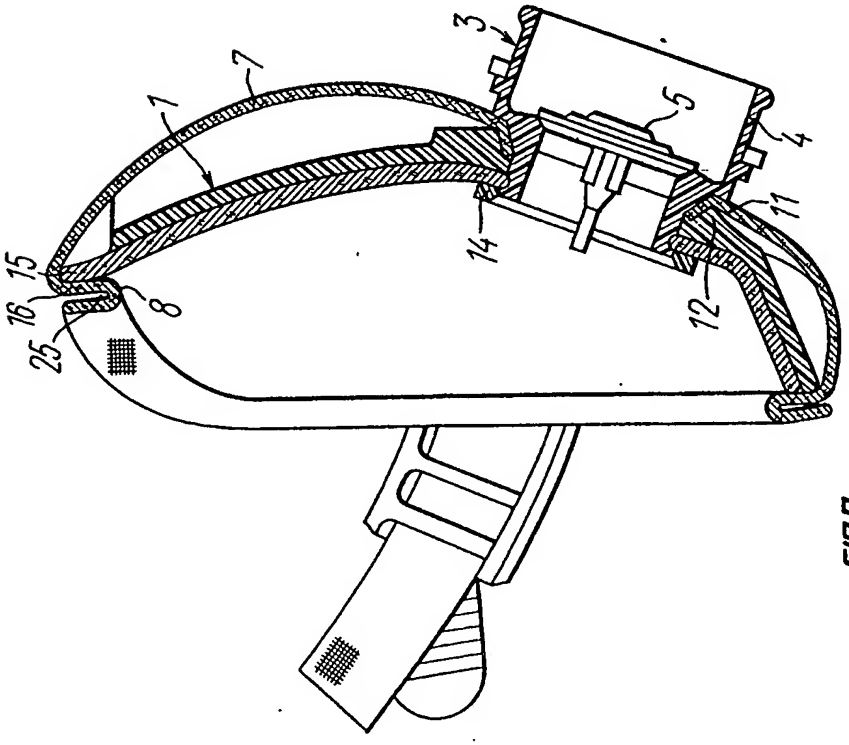

FIG2

SPECIFICATION
Respirator

The invention relates to individual means for protecting the respiratory organs of a man from aerosols (dust, smoke, fog) and gases, and more particularly to respirators of light type used when the content of oxygen in the surrounding medium is not less than 18 per cent by volume.

The invention may be used most effectively by attending personnel in the chemical industry, ferrous and non-ferrous metallurgy, and in other branches of industry wherein the air in the production rooms is contaminated by fluorine and chlorine gaseous compounds, gaseous sulphur and nitrogen compounds, and by phosphorus compounds.

What is desired is a light respirator for protection from aerosols and various gases, in which improved comfort and convenience in operation along with the reliable protection of respiratory organs of wearers with different anthropometric data will be ensured due to an appropriate arrangement of the filtering materials. The present invention provides a respirator comprising a cup-shaped mask enclosing the mouth and nose of a wearer and having openings made to pass air in and out of the space under the mask an edge adapted to be hermetically fitted to the face of the wearer, two layers of different filtering materials disposed thereon and featuring the shape corresponding to the shape of the mask, fastening means for securing the mask to the face of the wearer, and an exhalation valve detachably secured in the mask opening opposite the mouth of the wearer, in which the first filtering layer is made of an aerosol filtering material a peripheral edge of which is folded over the mask edge and secured there (e.g. by a bracing rubber cord) so that the mask edge fits the face of the wearer through the layer of the filtering material in which opposite the exhalation valve is made an opening through which the exhalation valve projects outside and edges of this opening are hermetically secured to the mask, and the second filtering layer is made of a material possessing chemisorption gas absorptive properties and this second layer of the filtering material is detachably secured on the internal surface of the mask so that its edge fits to the edge of the first layer of the filtering material folded over the mask edge, and has in the zone of the exhalation valve an opening the edges of which are hermetically secured to the internal surface of the mask.

Such an embodiment of the respirator:

— enlarges the filtering surface of the respirator, as the filters are disposed on the surface of the perforated mask;

— extends the time of the respirator protective action;

— simultaneously protects the respiratory organs from dust, smoke, fog, and gases, as the aerosol and gas filters are disposed on the surfaces of the mask, which imparts universal properties to the respirator;

— provides an easy change of the filters independently from each other;

— improves comfort in use of the respirator due to a more uniform and soft contact of the respirator with the face of the wearer;

— ensures low resistance to breathing (e.g. from 2 to 3 mm of water column);

— provides hermetic fitting of the respirator to the face of the wearer.

It is desirable that the second layer of filtering material be made of an ion-exchange fibre material.

Such an embodiment of the respirator ensures the trapping of noxious gaseous compounds, relieves the pressure exerted along the line of the respirator contact with the face of the wearer, provides low resistance to breathing as the resistance to breathing of the ion-exchange material does not exceed 3 mm of water column, prevents condensation of water vapours in the space under the mask due to high hydrophilic properties of the ion-exchange material, while moistening of the material improves its sorption activity and extends the time of the respirator protective action.

The elements holding the mask to the face of the wearer may be detachably secured to the exhalation valve and the valve may be secured in the mask opening by means of a removable fastening ring disposed inside the mask so that the edges of the opening in the second layer of the filtering material get under said ring and are hermetically forced against the internal surface of the mask.

Such an embodiment of the respirator makes it possible to perform preventive cleaning of the exhalation valve, replace the exhalation valve flap, change the filtering materials on the external and internal surfaces of the mask, secure them on the cover member, and hermetically seal the area where the exhalation valve is aligned with the mask and filters.

A section of the mask edge disposed opposite the nose bridge may have a curved portion fitting over the nose bridge and the first layer of the filtering material may be placed in the curved portion so that this section of the edge fits the nose bridge through the first layer of the filtering material.

Such an embodiment of the respirator eliminates local pressure and prevents formation of sores in the nose bridge area, as the curved portion forms a "bed" for the nose bridge cushioned by the filtering material folded inside the cover member, makes it possible to adjust the perimeter of the respirator contact with the face of the wearer which is important for unification of respirator standard sizes, and allows wearing of the respirator together with goggles.

The edge of the mask fitting the face of the wearer may be suitably provided with cut-outs the depth of which amounts to 33—50 per cent of the mask depth.

Such an embodiment of the respirator gives an optimum solution of the problem pertinent to the relation between the stiffness and flexibility of the mask, makes it possible to fit the respirator to faces of different dimensions and anthropometric data and permits changing of not only the perimeter of the mask hermetic fitting to the face of the wearer but also the shape of the edge contacting the face of the wearer.

The cut-outs in the mask edge may be preferably made triangular in shape.

Such an embodiment of the respirator widens the possibility of fitting the respirator to faces of different dimensions and specific anthropometric features by changing the acute angle of the cut-out, improves flexibility and elasticity of the mask and retains the elastic properties thereof along with the moving ability of the surfaces separated by the cut-outs.

The invention will now be described in greater detail, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a part cut-away general view of a respirator, with a gas filter arranged on the inner surface of the mask;

Figure 2 is a vertical section through the respirator; and

Figure 3 illustrates a mask with stiffening ribs.

The respirator comprises a mask 1 (Figure 1) made of polyethylene with openings 2 for letting air in and out of the space under the mask. The mask 1 has an exhalation valve 3 comprising a nipple 4 (Figure 2) internally accommodating a rubber flap 5. The nipple 4 is secured in an opening 6 (Figure 3) of the mask 1 (Figure 1) for the exhalation valve 3. Arranged on the outside of the mask 1 is a first filtering layer 7 made of an aerosol filtering material FPP (Petryanov's aerosol filter) a peripheral edge 8 of which is folded over the edge 9 of the mask fitting the face. The first layer 7 of filtering material is secured on the mask 1 with a bracing rubber tie cord 10 so that the edge 9 of the mask 1 fits the faces of the wearer through the first layer 7 of filtering material. The exhalation valve 3 (Figure 2) projects outside through an opening in the layer 7. The edge 11 of the opening in the first layer 7 of filtering material is hermetically secured to a wall 12 of the opening 6 (Figure 3) of the mask 1. A second filtering layer 13 (Figure 1) is made of a material possessing chemisorption gas absorptive properties, and this second layer 13 is detachably secured on the internal surface of the mask 1 so that an edge 15 of the second layer fits to the edge 8 of the first layer of filtering material folded over the edge 9 (Figure 1) of the mask on a section 16 (Figure 2). The valve 3 is secured in the opening 6 (Figure 3) of the mask by means of a removable fastening ring 14 (Figure 2) internally arranged in the mask 1 so that the edge of the opening in the second layer 13 of filtering material lies under the ring and is hermetically forced against the internal surface of the mask 1, thereby sealing the location of the exhalation valve 3 and also securing the second layer 13 to the mask.

Provided on a section of the edge 9 of the mask 1, disposed opposite the nose bridge of the wearer is a curved portion 17 fitting over the nose bridge and accommodating the first layer 7 of filtering material so that this section of the edge 9 fits the nose bridge through the first layer 7 of filtering material. Fastening elements of the mask 1 are detachably secured to the exhalation valve 3 and made in the form of an elastic fastening frame 18 with a protective shield 19 for the rubber flap 5 (Figure 2) of the exhalation valve and an elastic head band 20 (Figure 1) made of a textile-braided rubber. Made in the mask edge 9 fitting the face of the wearer are triangular cut-outs 21 whose depth amounts to 33—50 per cent of the depth of the mask 1, intended to impart more flexibility and elasticity to the mask with the aim of ensuring that the respirator fits faces of different dimensions and anthropometric features.

The cup-shaped mask 1 (Figure 3) has over its entire surface the openings 2 with stiffening ribs 22 arranged therebetween, while symmetric triangular cut-outs 21, 23, and 24 are made in the edge 9. Provided in the lower portion of the mask 1 opposite the mouth of the wearer is the opening 6 with cut-outs for accommodating the nipple 4 (Figure 2) of the exhalation valve 3 comprising the rubber flap 5, so that the exhalation valve 3 projects outside the surface of the mask 1. The exhalation valve nipple 4 has projections and flats for connection to the mask 1. Mounted on the external portion of the nipple 4, having the shape of a cylinder, are fastening elements in the form of the circular protective shield 19 (Figure 1) designed to protect the rubber flap 5 (Figure 2) of the exhalation valve 3 from the action of heat radiation and from contamination. The protective shield 19 (Figure 1) is combined with the fastening frame 18 having buckles 25 with the elastic head band 20 inserted therein. The removable fastening elements make it possible to subject the exhalation valve 3 to preventive treatment and to replace the rubber flap 5 (Figure 2).

Arranged on the external surface of the mask 1 (Figure 1) is the aerosol filter element 7 manufactured from a fibrous electrostatically charged material made up of ultrathin polymeric fibres equal in diameter, of the type of homogeneous and light material known as FPP (Petryanov's aerosol filter), possessing a high filterability, and made in the form of a circular filter with a circular cutout in the lower portion corresponding to the level of the exhalation valve 3 of the mask 1. The presence of an electrostatic charge in the material FPP imparts not only the high filtering properties thereto: the use of these charges serves as a means of ensuring a soft and reliable sealing (sticking) of the respirator along the line of fitting of the peripheral edge 8 of the filter to the face skin, thereby allowing penetration of non-filtered air to be practically excluded. Other filtering materials meeting the requirements of respirator specifications may also be used as an aerosol filter.

The second layer 13 of filtering material disposed on the internal surface of the mask 1 is a gas filter with chemisorption properties based on ion-exchange fibre material 5—6 mm thick having a low resistance to breathing not exceeding 3 mm of water column, or any other chemisorption material on a fibrous base meeting the requirements of respirator specifications. The ion-exchange material possesses moisture absorption properties and prevents condensation of water vapours in the space under the mask. When the ion-exchange material is moistened, its sorption activity is enhanced and the time of its protective action is extended.

The gas filter has a service life longer than that of the aerosol filter. Provided in the lower portion of the gas filter is an opening for passing the exhalation valve 3 (Figure 2) inside the mask 1. The exhalation valve 3 is made so that in places of its connection with the mask 1, the first aerosol filtering layer 7 is hermetically secured to the external surface of the mask 1 due to which the opening 6 (Figure 3) is sealed from the outside by means of the nipple 4 (Figure 2) at the expense of forcing the edge 11 of the opening in the first layer 7 of the filtering material against the opening 6 (Figure 3) of the mask. Usually the dimension of the opening in the filtering material is made 2—3 mm smaller than the dimension of the circular opening 6 in the mask due to which the filtering material is snugly forced by the exhalation valve nipple 4 against the edges of the opening 6. The internal layer 13 (Figure 1) of the gas filtering material is secured with the aid of the fastening ring 14 in order to provide a hermetic seal with the opening 6 (Figure 3). Such an embodiment of the seal prevents noxious gas compounds from getting in the space under the mask.

The aerosol filtering layer 7 (Figure 1) disposed on the external surface of the mask 1 has its peripheral edge 8 folded along the perimeter and secured by the spot welding to form a cavity 25 (Figure 2) internally accommodating the rubber textile-braided cord 10 the ends of which are brought outside. When bringing the opening 6 (Figure 3) for the exhalation valve in register with the opening in the aerosol filtering layer 7 (Figure 1) after the latter has been placed (with the gauze facing upward) on the external surface of the mask 1, the ends of the rubber cord 10 should be tightened until the aerosol filtering layer 7 takes the shape of the mask, with the mask 1 and the aerosol filtering layer 7 being maintained in the relative position. The peripheral edge 8 of the aerosol filtering layer 7 is folded over the edge 9 of the mask, covers the projecting edges of the gas filtering layer 13, and comes in contact therewith so as to form a peripheral edge 8 with a width of 1—2 cm, preventing the passage of air between the mask and the face of the wearer.

When the aerosol filtering layer 7 comes in contact with the gas filtering 13 the line of sealing is also formed along the entire perimeter of the edge 9, which substantially improves reliability of the respirator. The presence of the curved portion 17 at the top of the mask 1, arranged perpendicularly to the nose bridge and corresponding in shape to the prominence of the nose bridge, cushions the pressure of the respirator against the face in this area and pulling on the cord 10 of the aerosol filtering layer when fitting the respirator to the face of the wearer makes it possible to ease off the pressure exerted on the nose bridge. Tightening or slackening the cord 10 of the aerosol filtering layer 7 along with straightening out the edges 8 of the adjacent aerosol filtering layer 7 allows the respirator to be fitted in size and shape thereof. The curved portion 17 widens the field of vision of the wearer and makes it possible to wear the goggles together with the respirator.

The service life of the changeable aerosol and gas filters can be varied depending on the kind of work and contamination of the surrounding medium by using the moisture absorbing chemisorption material with improved hygienic properties, with addition of the non-ion-exchange fibres in different proportions or by other known methods.

The respirator mask has the cut-outs 21, 23, 24 made along its edge to a depth amounting to 33—50 per cent of the depth of the mask 1 and dividing its edge 9 into sections fitting the nose bridge, lower walls of the orbital cavities, cheeks, and the chin. The cutout 24 in the chin area is symmetric about a longitudinal stiffening rib 26, while the remaining cut-outs 21, 23 are symmetric about the rib 26 so that one of the sides is an extension of the transverse stiffening ribs. Such an embodiment of the mask 1 ensures a more uniform and soft fitting to the face irrespective of its anthropometric features due to imparting a greater elasticity to the mask 1. In this case, it is possible to vary not only the length of the line of the hermetic contact of the respirator edge with the face of the wearer but also to change the shape of this line of contact.

CLAIMS

1. A respirator comprising a cup-shaped mask for enclosing the mouth and nose of a wearer, the mask having openings for passing air in and out of the space under the mask and an edge adapted to be fitted to the surface of the face, first and second layers of different filtering materials disposed on the mask and corresponding in shape to the mask, fastening elements for securing the mask to the face, and an exhalation valve detachably secured in a mask opening positioned opposite the mouth of the wearer in use, the first filtering layer being of an aerosol filtering material a peripheral edge of which is folded over the edge of the mask and secured there so that the mask edge fits the face of the wearer through the first layer of the filtering material, the first layer having an opening through which the exhalation valve projects outside, the edge of this opening being hermetically secured to the mask, the second filtering layer being of a material possessing chemisorption gas absorptive properties and being detachably secured on the internal surface of the mask so that its edge is adjacent to the edge of the first layer folded over the edge of the mask, the second layer having in the region of the exhalation valve an opening whose edge is hermetically secured to the internal surface of the mask.

2. A respirator as claimed in claim 1, in which the second filtering layer is made of an ion-exchange fibre material.

3. A respirator as claimed in claim 1 or 2, in which the fastening elements securing the mask to the face are detachably fastened to the exhalation valve and the valve is secured in the corresponding mask opening by means of a detachable fastening ring disposed inside the mask so that the edges of an opening in the second layer of filtering material lie under the ring and are hermetically forced against the internal surface of the mask.

4. A respirator as claimed in any of claims 1 to 3, in

which a section of the mask edge positioned opposite the nose bridge of the wearer, in use, has a curved portion fitting over the nose bridge and accommodating the first layer of the filtering material so that this section of the edge fits the nose bridge through the first layer of the filtering material.

5. A respirator as claimed in any of claims 1 to 4, in which cut-outs whose depth amounts to 33—50 per cent of the depth of the mask are made in the mask edge for fitting the face of the wearer.

6. A respirator as claimed in claim 5, in which the cut-outs are triangular.

7. A respirator as claimed in any of claims 1 to 6, in which the folded edge of the first layer is secured by a tie cord.

8. A respirator substantially as described herein with reference to and as illustrated by the accompanying drawings.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa, 12/1986. Demand No. 8817356.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.